MR-histology Correlation in Ex-vivo Human Prostate Specimens

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Synopsis *(Included in proceedings but not used for review.)*
Accurate correlation can be achieved between MR imaging, gross anatomic sections, and histologic sections in human prostatectomy specimens using a combination of injected acrylic paint fiducials, plane-finding device, and standard tissue processing.

Purpose: MRI provides potential to diagnose prostate cancer with sufficient sensitivity and specificity. Prior investigations have compared MRI images of the prostate to histologic sections, but have encountered difficulty in ensuring that plane of the tissue section is in adequate alignment with the imaging plane.[1] We have developed a method of scanning and tissue processing to achieve MR–histologic correlation in ex-vivo human prostate specimens.

Material and Methods: A human prostate specimen was obtained, with appropriate informed consent, after prostatectomy for prostate cancer. Three acrylic paint markers were injected into the specimen to define the plane of imaging. The specimen was then placed on a polycarbonate platform that could be rotated in three dimensions, and adjusted such that the acrylic paint markers were all aligned in the horizontal imaging plane.[2,3] Small rods were used to anchor the prostate to the platform, which was locked in position. The prostate was imaged in a GE 1.5T EXCITE whole body scanner, using a Fast Spin Echo (FSE) protocol: TE = 130 ms, TR = 4750 ms, ETL = 18, BW = 15.63, 1mm slice thickness, 50 slices, 4 NEX, 5.5 cm FOV, 512 x 512 matrix size. The prostate was scanned again, in identical orientation, after fixation in formalin for 36 hours. The prostate was embedded in wax, and then sliced in 3mm sections in the plane of imaging. Photographs of the sliced sections were taken by a camera mounted perpendicularly to the plane of imaging.[4] These sliced sections were then processed, in the standard fashion, to create hematoxylin and eosin stained slides. These slides were digitized using a video microscopy system. Digital imaging software was used to create registration maps of the MR, tissue, and histology images. Corresponding registration points, 30 per histologic section, were placed on the injected fiducials, anchoring rods, and internal anatomic structures, such as blood vessels, glands, and prostate nodule boundaries. The position of these registration points was compared.

Results: Qualitatively and quantitatively, excellent correlation was achieved between MR, histologic, and gross anatomic images. Accuracy of the method was determined by the degree of non-alignment of registration marks placed on each section. 30 registrations marks on each of three sections were compared, which revealed an average displacement of 0.86 ± 0.19mm (mean ± SD). This compares favorably to the in-plane voxel dimension. A two-dimensional non-warping transformation of the histologic section, a method used to correct for spatial distortion after histologic processing, did not improve the alignment of the registration marks in each section.[5]

Conclusions: This method can be used to create gross anatomic and histologic sections of the prostate in the plane of MR imaging, with accurate correlation.

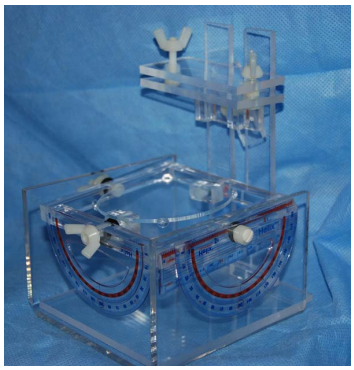

Figure 1: Polycarbonate plane finding device.

Figure 2: Representative gross anatomic, MRI, and histologic section with registration markers. The 3 injected fiducials, an acrylic metallic paint, can be seen in all three sections. Arrows indicated injected fiducials.

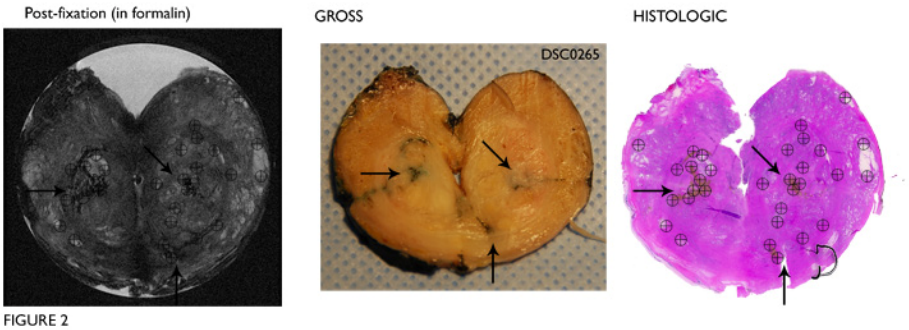

FIGURE 2

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